## AMENDMENTS TO THE CLAIMS

1. (Currently Amended) An image pixel structure, comprising:

a semiconductor substrate of a first conductivity type having a surface;

a gate over ~~a~~ said surface of the substrate; ~~and~~

a floating diffusion region within said substrate;

a channel region under said gate; and

a photodiode within said substrate, said photodiode including a substrate region of said first conductivity type and an implant region of a second conductivity type, said substrate region and implant region forming a junction for generating charge in response to light, said implant region including:

a first portion ~~of said implant region~~ extending underneath a majority of said junction, having a lower boundary in said substrate, and extending further towards a region of said substrate beneath said gate than a second portion of said implant region extends towards said region beneath said gate,

~~wherein~~ said second portion ~~is~~ adjacent to and substantially underneath said first portion such that said lower boundary of said first portion forms an upper boundary for at least a part of said second portion, said second portion extending underneath a majority of said junction, and

a third portion extending further towards said region of substrate beneath said gate than said first and second portions extend toward said region beneath said gate to increase charge transfer from said implant region to said floating diffusion region when said gate is switched on and having a donor concentration of said second conductivity type less than said first and second portions to reduce short-channel effects or punch-through between said implant region and floating diffusion region when said gate is switched off.

2. (Original) The image pixel structure of claim 1, wherein the substrate is p-type, and the implants are n-type.

3. (Original) The image pixel structure of claim 1, wherein the substrate is n-type, and the implants are p-type.

4. (Previously Presented) The image pixel structure of claim 1, wherein an upper portion of said implant region is farther away from the region beneath said gate than portions of the implant region located beneath said upper portion.

5. (Previously presented) The image pixel structure of claim 1, wherein said first portion is nearest the substrate surface in the implant region.

6. (Previously Presented) The image pixel structure of claim 8, wherein a donor concentration of the first portion is between $5E16/cm^3$ and $5E17/cm^3$.

7. (Canceled)

8. (Previously Presented) The image pixel structure of claim 1, wherein a donor concentration of the second portion is less than a donor concentration of the first portion.

9. (Currently Amended) The image pixel structure of claim 1, wherein the implant region includes a ~~third~~ fourth portion, said ~~third~~ fourth portion being underneath the second portion in the implant region.

10. (Currently Amended) The image pixel structure of claim 9, wherein a donor concentration of the ~~third~~ fourth portion is less than a donor concentration of the first portion.

11. (Currently Amended) The image pixel structure of claim 9, wherein the first, second, and ~~third~~ fourth portions of the implant region are formed by implants angled between 0 and 30 degrees in the direction of the gate, said angle being measured away from a line normal to the surface of the substrate, with at least one of the implants being at an angle greater than 0 degrees.

12. (Currently Amended) The image pixel structure of claim 11, wherein the ~~third~~ fourth portion extends further than the first and second portions towards the region of said substrate beneath said gate.

13. (Currently Amended) The image pixel structure of claim 9, wherein the implant angle for the first and second portions of the implant region is between 0-15 degrees, and the implant angle for the ~~third~~ fourth portion is between 0-30 degrees, at least one of said implant angles being greater than 0 degrees.

14. (Currently Amended) The image pixel structure of claim 12, wherein the implant angle for the first and second portions of the implant region is between 0-10 degrees, and the implant angle for the ~~third~~ fourth portion is between 0-15 degrees.

15-18. (Canceled).

19. (Currently Amended) The image pixel structure of claim 18, wherein the first, second, and ~~third~~ fourth portions of the implant region are formed by implants angled between 0 and 5 degrees in the direction of the gate, said angle being measured away from a line normal to the surface of the substrate.

20. (Currently Amended) The image pixel structure of claim 19, wherein the ~~fourth~~ third portion is formed by an implant angled between 10 and 30 degrees in the direction of the gate, said angle being measured away from a line normal to the surface of the substrate.

21. (Original) The image pixel structure of claim 1, wherein at least one of said portions of said implant region is angled.

22. (Original) The image pixel structure of claim 1, wherein the image pixel structure is a CCD imager.

23. (Original) The image pixel structure of claim 1, wherein the image pixel structure is a CMOS imager.

24. (Original) The image pixel structure of claim 23, wherein said image pixel structure is one of a three transistor (3T), four transistor (4T) five transistor (5T), six transistor (6T) and seven transistor (7T) structure.

25. (Original) The image pixel structure of claim 1, wherein said gate includes a gate oxide and a conductor.

26. (Original) The image pixel structure of claim 25, wherein said conductor contains at least one of poly-silicon, silicide, metal, and any combination of poly-silicon, silicide and metal.

27. (Original) The image pixel structure of claim 25, wherein said gate includes an insulator over the conductor.

28. (Original) The image pixel structure of claim 27, wherein the insulator is formed from at least one of oxide, nitride, metal oxide, and any combination of oxide, nitride, and metal oxide.

29-53. (Canceled)

54. (Withdrawn-Currently Amended) A pixel imager system, comprising:

(i) a processor; and

(ii) a CMOS imaging device coupled to said processor and including:

a pixel array, at least one pixel of said array comprising:

a semiconductor substrate of a first conductivity type having a surface;

a gate over ~~a~~ said surface of the substrate; ~~and~~

a floating diffusion region within said substrate;

a channel region under said gate; and

a photodiode within said substrate, said photodiode including a substrate region of said first conductivity type and an implant region of a second conductivity type, said substrate region and implant region forming a junction for generating charge in response to light, said implant region including:

a first portion ~~of said implant region~~ extending underneath a majority of said junction, having a lower boundary in said substrate, and extending further towards a region of said substrate beneath said gate than a second portion of said implant region extends towards said region beneath said gate,

~~wherein~~ said second portion ~~is~~ adjacent to and substantially underneath said first portion such that said lower boundary of said first portion forms an upper boundary for at least a part of said second portion, said second portion extending underneath a majority of said junction, and

a third portion extending further towards said region of substrate beneath said gate than said first and second portions extend toward said region beneath said gate to increase charge transfer from said implant region to said floating diffusion region when said gate is switched on and having a donor concentration of said second conductivity type less than said first and second

portions to reduce short-channel effects or punch-through between said implant region and floating diffusion region when said gate is switched off.

55. (Withdrawn) The pixel imager system of claim 54, wherein the substrate is p-type, and the implants are n-type.

56. (Withdrawn) The pixel imager system of claim 54, wherein the substrate is n-type, and the implants are p-type.

57. (Withdrawn) The pixel imager system of claim 54, wherein an upper portion of said implant region is farther away from the region beneath said gate than portions of the implant region located beneath said upper portion.

58. (Withdrawn) The pixel imager system of claim 54, wherein said first portion is nearest the substrate surface in the implant region.

59. (Withdrawn) The pixel imager system of claim 61, wherein a donor concentration of the first portion is between $5E16/cm^3$ and $5E17/cm^3$.

60. (Canceled).

61. (Withdrawn) The pixel imager system of claim 54, wherein a donor concentration of the second portion is less than a donor concentration of the first portion.

62. (Withdrawn-Currently Amended) The pixel imager system of claim 54, wherein the implant region includes a ~~third~~ fourth portion, said ~~third~~ fourth portion being underneath the second portion in the implant region.

63. (Withdrawn-Currently Amended) The pixel imager system of claim 62, wherein a donor concentration of the ~~third~~ fourth portion is less than a donor concentration of the first portion.

64. (Withdrawn-Currently Amended) The pixel imager system of claim 62, wherein the first, second, and ~~third~~ fourth portions of the implant region are formed by implants angled between 0 and 30 degrees in the direction of the gate, said angle being measured away from a line normal to the surface of the substrate, with at least one of the implants being at an angle greater than 0 degrees.

65. (Withdrawn-Currently Amended) The pixel imager system of claim 64, wherein the ~~third~~ fourth portion extends further than the first and second portions towards the region of said substrate beneath said gate.

66. (Withdrawn-Currently Amended) The pixel imager system of claim 62, wherein the implant angle for the first and second portions of the implant region is between 0-15 degrees, and the implant angle for the ~~third~~ fourth portion is between 0-30 degrees, at least one of said implant angles being greater than 0 degrees.

67. (Withdrawn-Currently Amended) The pixel imager system of claim 65, wherein the implant angle for the first and second portions of the implant region is between 0-10 degrees, and the implant angle for the ~~third~~ fourth portion is between 0-15 degrees.

68-69. (Canceled).

70. (Withdrawn-Currently Amended) The pixel imager system of claim ~~69~~ 54, where the implant dose of the ~~fourth~~ third portion is between 2E11-1E13/cm$^2$.

71. (Canceled).

72. (Withdrawn-Currently Amended) The pixel imager system of claim ~~71~~ 62, wherein the first, second, and ~~third~~ fourth portions of the implant region are formed by implants angled between 0 and 5 degrees in the direction of the gate, said angle being measured away from a line normal to the surface of the substrate.

73. (Withdrawn-Currently Amended) The pixel imager system of claim 72, wherein the ~~fourth~~ third portion is formed by an implant angled between 10 and 30 degrees in the direction of the gate, said angle being measured away from a line normal to the surface of the substrate.

74. (Withdrawn) The pixel imager system of claim 54, wherein at least one of said portion of implant regions are angled.

75. (Withdrawn) The pixel imager system of claim 54, wherein the pixel imager system is a CCD imager.

76. (Withdrawn) The pixel imager system of claim 54, wherein the pixel imager system is a CMOS imager.

77. (Withdrawn) The pixel imager system of claim 76, wherein said imager device is one of a three transistor (3T), four transistor (4T) five transistor (5T), six transistor (6T) or seven transistor (7T) architecture.

78. (Currently Amended) An imager pixel structure comprising:

a semiconductor substrate of a first conductivity type having an upper surface;

a transistor gate structure formed over the upper surface of the substrate;

a floating diffusion region within said substrate;

a channel region under said gate; and

a photosensor within said substrate, said photosensor including ~~in~~ a substrate region of said first conductivity type and an implant region of a second conductivity type, said substrate region and implant region forming a junction for generating charge in response to light, said implant region including first, second, ~~and~~ third, and fourth implant portions, ~~constructed such that~~

said first implant portion ~~extends~~ extending underneath a majority of said junction and further towards a region of said substrate beneath said gate than at least one of said second and third implant portions,

~~wherein~~ said second portion ~~is~~ extending underneath a majority of said junction and being adjacent to and at least partially underneath said first portion, ~~and~~

said third portion ~~is~~ extending underneath a majority of said junction and being adjacent to and substantially underneath said ~~first~~ second portion, and

said fourth portion extending further towards said region of substrate beneath said gate than said first, second, and third portions extend toward said region beneath said gate to increase charge transfer from said implant region to said floating diffusion region when said gate is switched on and having a donor concentration of said second conductivity type less than said first, second, and third portions to reduce short-channel effects or punch-through between said implant region and floating diffusion region when said gate is switched off.

79. (Previously presented) The image pixel structure of claim 78, wherein said first implant portion extends further than both said second and third regions extend toward said region in the substrate beneath said gate structure.

80. (Previously presented) The image pixel structure of claim 78, wherein the first, second, and third portions of the implant region are formed by implants angled between 0 and 30 degrees in the direction of the gate, said angle being measured away from a line normal to the surface of the substrate, with at least one of the implants being at an angle greater than 0 degrees.

81. (Previously presented) The image pixel structure of claim 78, wherein the third portion extends further than the first and second portions towards the region of said substrate beneath said gate.

82. (Previously presented) The image pixel structure of claim 80, wherein the implant angle for the first and second portions of the implant region is between 0-15 degrees, and the implant angle for the third portion is between 0-30 degrees, at least one of said implant angles being greater than 0 degrees.

83. (Currently Amended) ~~An~~ The image pixel structure ~~comprising:~~ of claim 78, wherein:

~~a photosensor formed in a semiconductor substrate of a first conductivity type, the photosensor comprising:~~

~~a first angled implant region of a second conductivity type,~~ the first implant ~~region being~~ portion is formed by implanting second conductivity type ions into said substrate at a first angle with a first energy level;

~~a second angled implant region of a second conductivity type,~~ the second implant ~~region being~~ portion is formed by implanting said second conductivity type ions into said substrate at a second angle with a second energy level; and

~~a third angled implant region of a second conductivity type,~~ the third implant ~~region being~~ portion is formed by implanting said second conductivity type ions into said substrate at a third angle with a third energy level,

~~wherein~~ said first, second and third angles are within the range of about 0 to about 30 degrees from normal and at least one of said angles is greater than 0 degrees, and ~~wherein~~ at least one of said first, second, or third energy levels is not equal to the other energy levels~~; and~~

~~a transistor gate stack located at a surface of the semiconductor substrate adjacent said photosensor,~~

~~wherein a lower boundary for said first angled implant region creates an upper boundary for said second angled implant region, a lower boundary for said second angled implant region creates an upper boundary for said third angled implant region, and said first angled implant region extends further in a horizontal direction in said substrate than said second or third angled implant region extends~~.

84. (Previously Presented) The image pixel structure of claim 83, wherein said first, second, and third angles are within the range of about 0 to about 5 degrees from normal.

85. (Previously Presented) The image pixel structure of claim 83, wherein said first energy level is lower than said second and third energy levels.

86. (Previously Presented) The image pixel structure of claim 85, wherein said first energy level is in the range of about 5 to about 100 KeV.

87. (Previously Presented) The image pixel structure of claim 86, wherein the second energy level is within the range of about 50 to about 250 KeV.

88. (Previously Presented) The image pixel structure of claim 87, wherein the third energy level is within the range of about 100 to about 400 KeV.

89-94. (Canceled).

95. (Currently Amended) An image pixel structure, comprising:

a semiconductor substrate of a first conductivity type having a surface;

a gate over a surface of the substrate~~; and~~

a floating diffusion region within said substrate;

a channel region under said gate; and

a photodiode within said substrate, said photodiode including a substrate region of said first conductivity type and an implant region of a second conductivity type, said substrate region and implant region forming a junction for generating charge in response to light, said implant region comprising:

a first portion of said second conductivity type having a lower boundary in said substrate,

a second portion of said second conductivity type, said second portion contacting and substantially underneath said first portion such that said lower boundary of said first portion forms an upper boundary for at least a part of said second portion, ~~and~~

a third portion of said second conductivity type, said third portion contacting and substantially underneath said second portion such that said lower boundary of said second first portion forms an upper boundary for at least a part of said third portion, and

a fourth portion extending further towards said region of substrate beneath said gate than said first, second, and third portions extend toward said region beneath said gate to increase charge transfer from said implant region to said floating diffusion region when said gate is switched on and having a donor concentration of said second conductivity type less than said first, second, and third portions to reduce short-channel effects or punch-through between said implant region and floating diffusion region when said gate is switched off

~~wherein at least one of said portions extends further toward a region of said substrate beneath said gate than another one of said portions and said portions have respective donor concentrations that are equal or decrease in order of said first, second, and third portions~~.

96-97. (Canceled).

98. (Currently Amended) The image pixel structure of claim ~~96~~ 95, wherein a donor concentration of said ~~upper~~ first portion is greater than a donor concentration of said ~~lower portion~~ second and third portions.

99. (Currently Amended) The image pixel structure of claim 95, wherein ~~a lower portion~~ lower portions of said implant region ~~is~~ are farther away from the region beneath said gate than portions of the implant region located above said lower ~~portion~~ portions.

100. (Currently Amended) The image pixel structure of claim 99, wherein an implant angle of said ~~lower~~ third portion, measured from orthogonal to said surface of said substrate, is at least 10 degrees less than an implant angle of said ~~upper~~ first portion.

101. (Currently Amended) The image pixel structure of claim 99, wherein a donor concentration of said ~~upper~~ first portion is greater than a donor concentration of said ~~lower~~ third portion.

102-103. (Canceled).

104. (Currently Amended) A pixel imager system, comprising:

(i) a processor; and

(ii) a CMOS imaging device coupled to said processor and including:

a pixel array, at least one pixel of said array comprising:

a semiconductor substrate of a first conductivity type having a surface;

a gate over ~~a~~ said surface of the substrate; ~~and~~

a floating diffusion region within said substrate;

a channel region under said gate; and

a photodiode within said substrate, said photodiode including a substrate region of said first conductivity type and an implant region of a second conductivity type, said substrate region and implant region forming a junction for generating charge in response to light, said implant region comprising

a first portion of said second conductivity type extending underneath a majority of said junction and having a lower boundary in said substrate,

a second portion of said second conductivity type extending underneath a majority of said junction, said second portion contacting and substantially underneath said first portion such that said lower boundary of said first portion forms an upper boundary for at least a part of said second portion, and

a third portion of said second conductivity type extending underneath a majority of said junction, said third portion contacting and substantially underneath said second portion such that said lower boundary of said second portion forms an upper boundary for at least a part of said third portion,

a fourth portion extending further towards said region of substrate beneath said gate than said first, second, and third portions extend toward said region beneath said gate to increase charge transfer from said implant region to said floating diffusion region when said gate is switched on and having a donor concentration of said second conductivity type less than said first, second, and third portions to reduce short-channel effects or punch-through between said implant region and floating diffusion region when said gate is switched off,

wherein ~~at least one of said portions extends further toward a region of said substrate beneath said gate than another one of said portions and~~ said first, second, and third portions have respective donor concentrations of said second conductivity type that are equal or decrease in order of said first, second, and third portions.

105. (Previously Presented) The pixel imager system of claim 104, wherein an implant angle of an upper portion of said implant region, measured from orthogonal to said surface of said substrate, is at least 10 degrees more or less than an implant angle of a lower portion of said implant region.

106. (Canceled).

107. ( Previously Presented) The pixel imager system of claim 104, wherein a lower portion of said implant region is farther away from the region beneath said gate than portions of the implant region located above said upper portion, and a donor concentration of said upper portion is greater than a donor concentration of said lower portion.

108-109. (Canceled).